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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/789,074
Filing Date: February 27, 2004
Appellant(s): GREYWALL, DENNIS S.

Yuri Gruzdkov (Reg. No. 50,762)
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed April 18, 2008 appealing from the Office action mailed October 29, 2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

DE 3,516,920	ROEDER	11-1985
US 5,240,488	CHADROSS	08-1993

Zhang et. al., "Multifunctional Carbon Nanotube Yarns by Downsizing an Ancient Technology", Science v.306(5700), 2004, pp.1358-1361. Note: reference sets forth general teachings in art originally presented by Hearle et. al. (Hearle, J., Grosberg, P., Backer, S., "Structural Mechanics of Fibers, Yarns, and Fabrics", Vol. 1 (Wiley New York, 1969)

Kumar et. al., "Synthesis, Structure, and Properties of PBO/SWNT Composites", Macromolecules 2002, 35, 9039-9043

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims **1, 3**, **6**, **8**, **9, 10**, **19, 20, 21, 26, 28**, **40**, **42, 45, and 47** are rejected under 35 U.S.C. 102(b) as being anticipated by Roeder (DE 3,516,920 – *Note rejections are based with reference to the machine translation and to the later submitted English language translation*). Support for the following rejection can be found in the machine translation of record and particularly in the noted passages ([P1, L1-13]; [P1, L18 to P2, L7]; [P2, L41-65]; [P3, L26-40]; [P4, L38-42]; [P5, L42 to P6, L6]).

1) The reference teaches producing a composite article comprising glass and carbon particles or "carbon fibrils" (**Claim 3**) "whose core zone is unidirectionally strengthened with continuous fibers". These fibers are "oriented by the structure…to the longitudinal axis of the semi-finished material" or substantially aligned (**Claim 26, 28, 40**)

2) The disclosed process is characterized by "impregnating (a carbon fiber) bundle to form a "glass containing carbon particles" (Claim 8) and it teaches that this body may be fabricated in accord with the "Sol-Gel" process (**Claim 9, 10**). During the process, the body may be imbued with an alcohol in addition to the glass powder or "at least one other material" (**Claim 13**). The reference teaches that this preform may be of low density (e.g. porous) and that it is advantageous to "consolidate the impregnated preform before (extruding the composite article)" (**Claims 12, 14**)

3) The composite article is formed from the heated preform by "a combined extruding and pulling through procedure" (**Claim 6**). As taught in the instant reference, the preform body is incorporated into a larger body which is made at least in part of glass and which has a hole and at least one other body (**Claims 15, 16, 18**). Upon the disclosed heating, the preform and glass body are "consolidated" (**Claim 17**), and by the extruding and pulling procedure, at least some of the glass is removed from the exterior portion of the carbon fiber by a mechanical process (**Claims 19, 20, 21**).

In view of Applicants claim amendments submitted in the reply dated July 23, 2007 and August 2, 2007, additional comments regarding the content of the Roeder disclosure are hereafter made with respect to the <u>English language translation</u> of German document DE 3,516,920.

Roeder teaches that in a preferred embodiment of the invention, carbon particles (e.g. filaments) are obtained from a stock fiber comprising many individual carbon particles. Specifically, the reference teaches (pages 22-23 of English language translation) that;

"The fibers are delivered in the form of continuous-fiber strands, comprising 500 individual fibers…provided with a sizing for protection and

for better handling. Since the sizing … prevents penetration of the glass powder between the filaments) it must be removed by immersion in a solvent or burned off by means of a Bunsen burner flame. At a temperature of ca. 600°C the individual filaments separate from one another. Prepared in this way, the fibers are now cut to a suitable length and combined into a fiber bundle, which comprises a large number of fiber strands."

It is evident from the above excerpt that the stock carbon material utilized in a preferred embodiment of the Roeder invention may take the form of a relatively large, "prefabricated" carbon fiber. This "prefabricated" fiber is separated into individual carbon filaments or "carbon particles" before to being subjected to the prior art infiltration process.

After separating the prefabricated bundle into individual filaments or "carbon particles" Roeder teaches that said filaments are cut to length and subsequently grouped into loose, bundles of fibers. Further, Roeder teaches (Page 14 of English language translation) that "The fiber bundle can be impregnated either by a suspension process…or by the sol-gel method (German Patent No 1941191 …), wherein the fiber bundle is immersed in a solution of metal alcoholates." This sol-gel impregnation process is implicitly understood to encompass Applicants claimed step of dispersing the carbon particles in a sol-gel solution (**claim 42, 45**) and "solidifying" at least a portion of the sol-gel solution to "form a glass body containing therein said carbon particles".

Finally, Roeder discloses that “during extraction from the hollow mandrel, the glass-impregnated fiber bundle is pre-compacted in the point of the hollow mandrel, which is tapered in the pulling direction” (Page 12 of English language translation).

It follows from the above series of excerpts that the Roeder discloses impregnating separated or loosely bundled carbon filaments (e.g. carbon particles) with a sol-gel solution to form a glass containing carbon particles. Further, it is the Examiners understanding that this glass with embedded carbon particles is “pre-compacted” during the drawing operation to yield a compacted carbon fiber from the separated or loose carbon filaments.

Claims 12, 13, 14, 15, 16, 17, 18, 43, 46, and 48 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Roeder (DE 3,516,920 *machine translation and English language translation*).

Claim 43, 46, 48 requires that the drawing step of the glass impregnated carbon fibers results in “ a plurality of aligned carbon fibers” and the said drawing step results in the expulsion of “glass located between and within said aligned carbon fibers. As discussed in the rejection under 35 U.S.C. 102(b) presented above, Roeder teaches that the drawing process results in carbon fibers which are substantially aligned parallel to the direction of drawing and further teaches that the drawing results in “pre-compaction” of the glass impregnated carbon fiber perform.

Roeder does not explicitly require that entrained glass is “expelled” from the glass infiltrated carbon fibers during this “pre-compaction” step. With this point in mind, it is the Examiners assessment, absent any compelling evidence to the contrary, that the claimed “expelling” action is either implicitly achieved during the disclosed compaction process or alternately that such an action would have presented an obvious extension over the prior art teachings. Specifically, the reference teaches that it is known to compact the relatively low density glass impregnated carbon fibers to achieve a properly densified carbon reinforcement core in the produced glass fiber. It would have been obvious to one of ordinary skill in the art at the time of the invention to adjust the chosen level of compaction by expelling entrained glass in order to achieve the requisite level of fiber core densification or pre-compaction.

With respect to **Claims 12, 13, 14, 15, 16, 17, and 18**, the instant claims require in part the formation of a porous carbon/glass perform wherein more than one material infiltrates the carbon fibers, heating the perform to consolidate it, incorporating said perform into an apparatus having a hole sized to receive the body wherein said apparatus further comprises an additional body. As pointed out in the rejection under 102(b) above, the Roeder reference explicitly teaches each of the aforementioned limitations in a preferred embodiment of the invention with specific reference to the glass powder impregnated carbon particles (e.g. filaments).

The reference teaches that a sol-gel based infiltration method may be utilized to achieve substantially identical results to the preferred embodiment, however the

reference does not make explicit all of the details of the alternate sol-gel embodiment of the invention. It is the Examiners express position that the claimed limitations making use of the sol-gel infiltration process represent a merely trivial extension over the prior art teachings that would have been a merely obvious matter for one of ordinary skill in the art at the time of the invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 4,5, 7, 44, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roeder and the general teachings of Hearle et al. (as presented by Zhang et. al., Science v306, no. 5700, (2004), pp 1358-1361)).

The Roeder reference is silent regarding the performance of a twisting operation upon the fiber in the heated state. Zhang relates the following with reference to Hearle;

"a generic equation (9) provides useful insights for spinning nanotube yarns. Specifically, the ratio of yarn tensile strength (σ_y) to the tensile strength of the component fibers (σ_f) is approximately

$$\sigma_y/\sigma_f \approx \cos^2\alpha[1-(k \operatorname{cosec}\alpha)] \quad (1)$$

where $k = (dQ/\mu)^{1/2}/3L$, α is the helix angle that fibers make with the yarn axis, d is the fiber diameter, μ is the friction coefficient between fibers, L is the fiber length, and Q is the fiber migration length (i.e., the distance along the yarn over which a fiber shifts from the yarn surface to the deep interior and back again).

The $\cos^2 \alpha$ term in Eq. 1 describes the strength decrease of a twisted assembly of continuous fibers, which occurs because the fibers in the twisted yarn are inclined at the angle α with respect to the tensile axis. For short fibers, however, in the absence of twist there is little strength because there are no significant transverse forces to bind the fiber assembly together. The $[1 - (k \operatorname{cosec} \alpha)]$ term describes the generation of transverse forces by transfer of the tensile load to the yarn surface, which locks the fibers together as a coherent structure. The components of k show that the strength obtainable for a given level of twist increases with increasing coefficient of friction and fiber length and with decreasing fiber diameter and fiber migration length.

Effectively, Hearle teaches that twisting a fiber greatly increases the tensional rupture strength of the produced fiber over non-twisted fibers. It would have been obvious for one of ordinary skill in the art at the time of the invention with the Roeder and Hearle teachings in hand to twist the fiber as produced according to the Roeder method. This would have been an obvious modification to anyone seeking to increase the strength of the fiber.

Claims 22 is rejected under 35 USC 103(a) as being obvious over Roeder (DE 3,516,920) as applied to Claim 19 under §35 USC 102(b) above.

Roeder is silent regarding the use of a chemical process to remove at least a portion of the exterior glass from the from the carbon fiber. That said, the literature is replete with “chemical processes” (e.g. hydrogen fluoride) which provide a controlled etch of glass from a substrate. One familiar with the Art would reasonably be expected to recognize the impact of the thickness of an exterior coating upon the physical properties of the produced fiber. It would have been obvious for one of ordinary skill in the art at the time of the invention to utilize a “chemical process” to remove a portion of this external coating in order to achieve the desired thickness in the exterior glass layer of the as produced carbon fiber. The chemical removal of a portion of the exterior glass layer would have been an obvious approach to tailor the physical properties of the produced fiber by thinning the exterior glass coating.

Claim 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roeder as applied to Claim 45 under 35 USC 102(b) and in further view of Chandross (US 5,240,488).

Roeder is silent regarding the addition of an ester (e.g. at least one other material”) to the carbon particle/ sol gel mixture as set forth in the instant claim. Chandross Claim 4 teaches that “the pH-decreasing ingredient is added to the sol prior to introduction of the sol into the mold, and in which the pH-decreasing ingredient consists essentially of an ester whereby the rate of gellation is controlled”. It would have been obvious to one of ordinary skill in the art being aware of the Chandross teachings to add an ester to a sol-gel mixture in order to control the rate of gellation of

the sol. Where the rapid gellation of the sol in the Roeder process may lead to an unsuitably heterogeneous carbon particle preform, the addition of an ester would have been an obvious modification to the sol for one seeking to prolong the infusion period by extending the gellation time period.

Claims 2, 27, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roeder as applied under 35 USC 102(b) to claim 1, 26, and 40, respectively in further view of Kumar (Macromolesules 2002, 35, 9039-9043).

Roeder is silent regarding the use of carbon nanotubes as the carbon particles in the disclosed method for assembling carbon particles. Kumar recites multiple previous studies which confirm the “benefits of reinforcing polymer and other matrices with carbon nanotubes”. The instant reference figure 4, 5, and 6 point to beneficial advantages in the composite structures including a reduced thermal shrinkage, reduced weight loss with temperature, and an enhanced creep behavior at elevated temperature for the composite over virgin matrix material. It would have been obvious for one of ordinary skill in the art at the time of the invention, being aware of the confirmed benefits of reinforcing a matrix with carbon nanotubes, to substitute said nanotubes for the disclosed carbon fibers in the Roeder invention.

(10) Response to Argument

Rejections under 35 U.S.C. §102(b) and §103(a) over Roeder and/or combinations of references citing Roeder

With respect to the rejections of Claims 1-22, 26-28, and 40-49, Applicant presents the following arguments:

Argument #1)

With respect to the rejection of claims under 35 U.S.C. 102(b) in view of Roeder or under 35 U.S.C. 103(a) in view of combined references including Roeder, Applicant asserts that the claimed method requires drawing a glass containing carbon particles so as "to form at least one carbon fiber from said carbon particles". Applicant alleges that the Roeder process utilizes an "already formed fiber bundle" wherein said "prefabricated fiber bundle" is impregnated with glass and subsequently placed into a hollow mandrel for drawing. In contrast to the claimed invention, Applicant argues that Roeder uses an "already existing, previously formed carbon fiber" while the claimed invention requires that the carbon fiber is "newly formed as the glass is being drawn"

Applicant has previously acknowledged that the Roeder glass impregnated fibers are drawn through the mandrel to form a glass rod having a fiber reinforced core. Applicant has further acknowledged that prior to the step of impregnating the fibers, Roeder teaches a heat treatment step wherein "the spooled fibers is stripped off and the individual filaments of each fiber are loosened from one another". Although Applicant acknowledges that Roeder teaches separating a stock carbon fiber into individual filaments or individual carbon particles, Applicant argues that the preliminary stock fiber

never ceases to exist. Applicant concludes that since the stock carbon fiber never ceases to exist, the prior art can not teach forming a fiber from individual carbon filaments.

Applicant's argument on this matter is held to be unpersuasive

As set forth in the Office action dated October 29, 2007, Roeder explicitly teaches that the "individual filaments separate from one another" and through the subsequent drawing process, said "individual filaments" or particles are drawn to form a consolidated "fiber" core. Specifically, Roeder teaches (see pages 22-23 of the English language translation) that;

> "The fibers are delivered in the form of continuous-fiber strands … and they are provided with a sizing for protection and for better handling. Since the sizing has a negative effect on the quality of the composite … it must be removed by immersion in a solvent or burned off by means of a Bunsen burner flame. At a temperature of ca. 600oC <u>the individual filaments separate from one another</u>."

The fact that the stock carbon fiber is separated into constituent filaments or carbon particles prior to impregnation with glass is made plane by the foregoing passage. Further, Roeder explicitly teaches that drawing these glass impregnated filaments into final form results in "rods profiles, or the like …whose core zone is reinforced

unidirectionally by means of continuous fibers" (see Page 5 of the English language translation).

Now, Applicant presents multiple arguments directed to the nature of the stock carbon fiber, namely that "the previously formed carbon fiber does not cease to exist", that the "filament loosening is very slight", and that "neither the individual filaments nor the fibers in the bundle are reverted back to mere particles".

In response to these allegations, it is the Examiners position that the arguments directed to the nature of the loose bundle of individual filaments do not materially rebut the fact that individual carbon filaments or particles are drawn to form at least one fiber. Restated, Roeder teaches separating a stock carbon fiber into "individual filaments" or individual carbon particles and subsequently drawing said "individual filaments" to form a "continuous fiber". In view of the foregoing, it is evident that Roeder teaches an explicit step of drawing glass containing carbon particles to form at least one carbon fiber from said carbon particles" as required by Applicants independent claim 1.

Argument #2)

Next, Applicant purports a distinction between the carbon filaments set forth in the Roeder disclosure and the carbon particles required in the pending claim 1. Specifically, Applicant presents a definition from Merriam-Webster's Collegiate

Dictionary relating a particle as "a minute quantity or fragment" or a relatively small or the smallest discrete portion or amount of something".

Applicant’s argument on this matter is held to be unpersuasive.

It is first noted that Applicant has supplied no explicit definition for a particle in the specification as originally filed. Next, even accepting Applicants chosen definition of "a particle", it is in no manner evident to the Examiner why the prior art carbon filament would not meet every requirement of said definition. Specifically, it would appear to the examiner that, absent any compelling evidence to the contrary, the prior art filament may appropriately be construed at least as a minute quantity or fragment. For this reason, Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

Finally, to the extent that Applicant argues that the “filament loosening is very slight”, that “neither the individual filaments nor the fibers in the bundle are reverted back to mere particles”, and that Roeder’s filaments are too large to form a sol-gel solution”, Applicant is advised that the prior art process has been shown to read directly upon the claimed method for the reasons set forth above. Further, Applicant has provided no evidence on the record in support of the allegations regarding the nature of

Roeder's separated individual filaments. Since Applicant has provided no conclusive evidence in support of the instant allegations, it follows that said allegations are held to be mere conjecture and attorney argument.

The Official policy regarding Attorney argument is clearly outlined in MPEP §2145 [R-3];

> "Attorney argument is not evidence unless it is an admission, in which case, an examiner may use the admission in making a rejection. See MPEP § 2129 and § 2144.03 for a discussion of admissions as prior art. The arguments of counsel cannot take the place of evidence in the record. In re Schulze, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); In re Geisler, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997) ("An assertion of what seems to follow from common experience is just attorney argument and not the kind of factual evidence that is required to rebut a prima facie case of obviousness."). See MPEP § 716.01(c) for examples of attorney statements which are not evidence and which must be supported by an appropriate affidavit or declaration.

With respect to the rejections of Claims 10, 42, 45, and 47, Applicant presents the following arguments:

Argument #3)

Regarding the rejection of claim 45 under 35 U.S.C. §102(b), Applicant argues that the claimed invention requires a step of "dispersing carbon particles within a form of liquid glass to form a sol-gel solution". Applicant argues that the Roeder process

disperses glass particles in alcohol and that the carbon fiber bundle remains structurally intact. Applicant concludes that Roeder teaches solid glass particles are "simply aggregated" within the filament bundle but not that said filaments are dispersed in any manner at all. Nor, Applicant argues, does the Roeder reference teach a step of sol-gel solution solidification.

The Examiner strongly disagrees.

As set forth on pages 4-5 of the October 29, 2007 Office Action, Roeder teaches (page 14 of English language translation) that the filament bundle "can be impregnated either by a suspension process … or <u>by the sol-gel method</u> (German Patent No 1941191 …), wherein the fiber bundle is immersed in a solution of metal alcoholates." It is evident from the foregoing that Roeder in fact does teach a preferred embodiment wherein the individual carbon filaments are immersed or "dispersed" in a sol-gel solution. As noted in the grounds of rejection presented above, said sol-gel processing technique, by virtue of yielding a glass impregnated filament bundle, is implicitly understood to encompass the claimed step of “solidifying” at least a portion of the sol-gel solution to “form a glass body containing therein said carbon particles”. It follows that Applicants allegation stating that Roeder fails to teach the requisite sol-gel processing is held to be a clear misrepresentation of the prior art teachings.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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TQAS, TC 1700